

**National Marine Fisheries Service (NMFS)**  
**Application for a Permit for Scientific Purposes**  
**or to Enhance the Propagation or Survival of Threatened and Endangered Species**

- A. **Title:** (select one of the following:)
1. Application for Permit for Scientific Purposes under the Endangered Species Act of 1973.  
(e.g. for field surveys, genetics research, etc.)
- B. **Species:** List all species and/or populations and/or Evolutionarily Significant Units (ESUs) for which you request take authority.  
Puget Sound juvenile Chinook Salmon (*Oncorhynchus tshawytscha*), naturally-produced and artificially propagated
- C. **Date of Permit Application:** Date you are sending the application.  
1/23/2006
- D. **Applicant Identity:** The applicant is the individual and/or agency responsible for ensuring compliance with permit conditions, and may represent a group of individuals actually performing the activities (e.g., employees, partners, agents, and/or contractors). Please include the following information about the permit applicant:
1. Applicant's name and position title;  
Jason Toft, Fisheries Biologist
  2. Institution or agency name;  
University of Washington, School of Aquatic and Fishery Sciences
  3. Mailing address; and  
UW SAFS, Box 355020, Seattle, WA 98195
  4. Telephone and Fax number; and E-mail address.  
206-221-5460 (tel), 206-685-7471 (fax), tofty@u.washington.edu
  5. If NMFS should be coordinating with a contact person different from the applicant, please also include the same information (1-4 above) for the principal contact.  
N/A
- E. **Information on Personnel, Cooperators, and Sponsors.** (If the same person or entity will hold several roles, you may state their address information once and refer back to it).
1. If the applicant will not be the sole person conducting the proposed activities, provide the names, phone numbers, and résumés for each Principal Investigator and Field Supervisor. A Principal Investigator is ultimately responsible for the project and compliance with the permit conditions. A Field Supervisor (who may also be the Principal Investigator), is anyone who supervises or carries out the

activities in the field without supervision, and will also be responsible for compliance with the permit conditions.

Additional Principal Investigator: Jeffery Cordell, 206-543-7532. See attached for resumes.

2. To the extent possible, provide a list of field personnel.  
Lia Stamatiou, Sarah Heerhartz, Carl Young, Mike Cooksey, Ben Starkhouse, Danielle Potter, Beth Armbrust
3. Please identify the secured or proposed funding source(s) for the proposed activities, including names, addresses, and phone numbers of the sponsors, cooperating institutions, etc.  
Secured funding: Research in 2005 funded by the Port of Seattle will be continued in 2006. The 2006 research proposal is attached. Sponsor contact info:  
George Blomberg  
Health, Environmental, and Risk Services  
Port of Seattle  
P.O. Box 1209  
Seattle, WA 98111  
(206) 728-3194  
  
Proposed funding: Research in 2005 included work funded by the City of Seattle. No research is currently proposed or secured for 2006, but due to the similar nature of the research as well as past-collaborative efforts, the proposal from the 2005 research is attached. Sponsor contact info:  
Julie Hall  
Fisheries Ecologist  
Seattle Public Utilities  
700 5th Ave., Suite 4900  
PO Box 34018  
Seattle, WA 98124-4018  
(206) 233-7164
4. If the proposed activities will be conducted by a contractor, provide a statement that a qualified member of your staff (include name(s) and qualifications) will supervise or observe the taking. Include a copy of the proposed contract or a letter from the contractor indicating agreement to operate under any and all permit conditions, should a permit be granted.  
  
N/A
5. Provide a description of the arrangements for the disposition of any tissue samples, dead specimens, or other remains, either in a museum or other

institution, for the continued benefit to science. Include the list of researchers, laboratories, museums, and/or institutional collections that would receive these tissue samples or specimens. Please include name, address, contact, and phone number for each.

No intentional mortality of fish will occur. Fish will be handled in the field and returned immediately after counting and taking measurements of a subsample of fish for forklength, and diets using the non-invasive gastric lavage technique with which prey items are flushed from the stomach with a water spray. Any unintentional mortalities will be preserved in formalin and stored in our own laboratories at the University of Washington.

6. For transport and long-term holding of listed species, please provide the qualifications and experience of all staff responsible for care without supervision, including a written certification from a licensed veterinarian knowledgeable about the requested species (or similar species), or from a recognized expert on the species (or similar species) that he/she has personally reviewed the criteria for transporting and maintaining the animal(s) and that in his/her opinion they are adequate to provide for the well-being of the animal. Include the name and phone number of this veterinarian, consulting expert, or equivalent who will be available during the proposed activities.

N/A

F. **Project Description, Purpose, and Significance:** Please describe the purpose of your study or project. If available, please attach a copy of the formal project proposal or contract, including the contract number, to your application. You may reference the appropriate section of the proposal/contract in response to a particular question.

1. A justification of the objective(s): motivation, history, goals, etc., and how the wild populations of the species will benefit from the proposed activities;  
The motivation of the study is to monitor the success of restoration projects within the Duwamish River estuary. Specific sites along the Duwamish River have been restored for intertidal mudflat/emergent marsh habitat, which is beneficial for the juvenile salmonids that rear and migrate along this corridor. It is important to monitor these sites for fish presence and fish prey availability, in order to assess their function and help plan future restoration efforts. Our research will help illustrate the conditions that are conducive for the growth and survival of wild populations of juvenile Chinook salmon.
2. A statement of whether the proposed project or program responds directly or indirectly to a recommendation or requirement of a Federal agency (Include citations if applicable);  
Indirectly, yes: The monitoring is required by the Port of Seattle through a requirement by the Army Corps of Engineers.

3. A statement of whether the proposed project or program has broader significance than the individual project's goals, or is part of a larger scale research management or restoration plan (Include citations if applicable);

Our work is funded by the Port of Seattle, and involves constant collaboration with ongoing research by ourselves and other entities in the WRIA9 watershed.

4. A description of any relationships or similarities of the proposed activities to other proposed or ongoing projects and programs, and whether the potential exists to cooperate and coordinate with other similar studies or activities. (Include citations if applicable);

Research in 2005 was part of a larger framework including collaborations with the City of Seattle, King County, Port of Seattle, Fish and Wildlife Service, University of Washington, and Natural Resources Consultants. Although this research may continue based on available funding, secured funding for 2006 is for the Port of Seattle. We are not aware of similarities/overlap with other projects in 2006, but if any arise we will certainly encourage coordination with these same entities as was the case in 2005.

5. A justification for using listed species in the study or activities, and a discussion of possible alternatives to using listed species and/or to using the proposed methods. If applicable, you should try to anticipate alternative scenarios due to circumstances such as changes in environmental conditions, annual variations in species abundance, necessary changes in proposed procedures, etc. Such scenarios should be addressed in **Description and Estimates of Take** below if they affect the nature or amount of potential take of listed species. This planning may avoid the potentially lengthy process of modifying the permit.

The restoration sites were created to make habitat for listed species of Chinook salmon, therefore sampling must be able to assess whether juvenile Chinook salmon are utilizing the restoration sites, and to what extent. The peak of juvenile Chinook salmon migration through this system is May-July, during which times it would be impossible not to sample Chinook salmon using netting in such intertidal restoration sites. Alternatives to using listed species would have to involve netting during other seasons such as autumn to assess general fish utilization, during which the conditions are much different than the springtime and not directly comparable to the conditions present during peak juvenile Chinook migration. Invertebrate prey items also vary throughout the year, and therefore must be assessed during the juvenile Chinook migration. Our methodology does involve using gastric lavage to sample juvenile Chinook salmon diets, which is a non-lethal method. We do not preserve fish in order to obtain stomach contents. Therefore, diet-sampling using gastric lavage is the best known method, all other techniques involve the

mortality of fish. To our knowledge netting is the only method to sample for juvenile Chinook salmon at this position in the Duwamish estuary, due to high water turbidity and intertidal mudflats. We have used visual observations in more marine settings, but these are only effective during conditions of clear water and sand/gravel beaches.

G. **Project Methodology:** Please provide a detailed description of the project, or program, in which the listed species is to be used, including:

1. The proposed duration of the project or program, including start and end dates.  
We have been monitoring these restoration sites on the Duwamish since April 2004 under permit 1140, Study 2, as a collaborator with Casey Rice/NMFS. We plan to continue to monitor the development of the restoration sites dependent on successful funding from the Port of Seattle and the City of Seattle, which could last another five years (July 2011). It is important to monitor the development of young restoration sites both to monitor their performance as well as to provide valuable data to help guide future restoration efforts. Timeline of monitoring could continue on an annual basis during the initial development of the restoration sites dependent on funding and restoration site performance.
2. A discussion of the procedures and techniques which will be used during the project. The discussion should include, at a minimum:
  - a. Method(s) of capture and of release;  
*Enclosure Nets*  
The presence and abundance of fish in the restoration sites will be conducted using enclosure net sampling. This consists of deploying a 60-m long, 4-m deep, 0.64-cm mesh net at high tide to block the mouth of the cove of the restoration sites. Fish are removed with either a small pole seine (1.2-m. x 9.1-m., 0.64-cm mesh) or dip nets as the tide recedes, usually starting at mid-tide a few hours after net deployment. The restoration sites completely dewater at low tide, at which point all fish are removed. Fish are held in buckets with aerators during processing of species, numbers, and lengths. Hatchery and wild status of salmonids are determined to the extent possible by recording clipped adipose-fins and testing with coated-wire tag readers. Forklengths are measured on a subsample of salmonids, to at least  $n = 5$  for each: (1) species, (2) marked or unmarked status, and (3) size class. Standard lengths of all other fish are recorded for at least  $n = 20$ .  
  
*Beach Seines*  
The standard Puget Sound 37-m beach seine is used similar to the enclosure net methodology and specifications, but used to assess

presence and abundance of fish in the main channel habitat. The beach seine is deployed from a small boat, and pulled onto shore for processing of fish identical to the enclosure net methodology.

#### *Fish Diets*

Diets of juvenile salmonids are sampled by gastric lavage to at least  $n = 5$  for each: (1) species, (2) marked or unmarked status, and (3) size class. This method consisted of placing fish in a tray of seawater with a small amount of the anesthetic MS-222 for approximately 30 seconds. Each fish is removed from the tray and forklength measured; gut contents are then removed using a modified garden pump sprayer with a custom nozzle and filtered seawater. Such a gastric lavage system has been shown to cause 100% removal of food items and to have no adverse long-term effects in salmonids (Twomey and Giller 1990). Gut contents are washed into a 106- $\mu\text{m}$  sieve and fixed in 10% buffered formaldehyde solution. Fish are immediately placed in a bucket of aerated seawater for recovery (approximately 2-3 minutes), and then released.

- b. A description of any tags, including the attachment method, location, and expected duration of tag attachment;  
N/A
- c. A description of type and dosage of any drugs to be used, purpose of use, and method of application;  
A small amount of the anesthetic MS-222 (Tricaine methanesulfonate ) is used in order to handle the fish during fish-diet sampling (see above 2a). The method of application is according to the University of Washington IACUC Animal Care Protocol #2555-05. MS-222 is added to ambient water at a concentration of 30-50 mg/L, depending on the degree of anesthetization or sedation desired, the species and size of fish, and temperature and softness of water.
- d. Temporary holding time prior to release of the individual(s) and the manner in which they will be detained (for transport and long-term holding, please fill out the section on **Transport and Holding**); and  
Fish are placed in buckets with aerated water during processing of species, numbers, and lengths before release back to their original environment. Processing time varies on the number of fish caught, but is typically around 30 minutes. This processing takes place onsite, no transport is necessary.

- e. Number and types of samples to be taken from each individual, including sampling protocol.  
Fish are only sampled for diet as above in section 2a, no tissue, scale, or other body samples are taken.
3. A discussion of the potential for injury or mortality to the species involved, and the steps that will be taken to minimize adverse effects and to ensure that the species will be taken in a humane manner.  
It is possible for fish to be injured during net sampling; intertidal sampling using enclosure nets and beach seines are designed to minimize any adverse effects. We will use the following techniques to make sure that any harmful effects of net sampling are negligible or minimal: (1) Having sufficient buckets and aerators so that fish will not be stressed during processing time of species, numbers, forklengths, and diet samples. (2) Having sufficient field personnel to minimize processing time, so that fish are released as quickly as possible, and (3) If the number of fish is too many to process efficiently, we will subsample the fish catch to avoid unintentional mortalities due to stress.

H. **Description and Estimates of Take:** Issued permits define a specific number of individuals of each species that can be taken within the approved study or project. You must provide sufficient detail (in the table or in narrative) for NMFS to determine the species, population group, and estimated number of individuals to be "taken" due to each activity. You should also describe the specific age, size, (and sex, if appropriate) of the listed species targeted. Please take into account alternative scenarios identified above in **Project Description, Purpose, and Significance.**

The description of the listed species to be taken during the proposed activities should include the following:

1. A list of each species and/or population and/or Evolutionarily Significant Unit to be taken including the common and scientific name. Include specific population or sub-population groups if appropriate.  
Puget Sound juvenile Chinook Salmon (*Oncorhynchus tshawytscha*), naturally-produced and artificially propagated
2. The sampling schedule, including locations and dates if available. Be as specific as possible. Locations should be listed from general to most specific, including bodies of water, rivers, tributaries, streams or creeks, and a geographical descriptor (e.g., Columbia River, Snake River, Imnaha River, River Mile 42 or Gulf of Mexico, Louisiana Coast, Sabine Pass). Include latitude/longitude coordinates, if possible.  
Location is in the Duwamish River estuary, flowing into the City of Seattle, King County, Washington. This is in WRIA9, and focuses in the Turning Basin region of the Duwamish River, around river mile 5.3 (Lat

47 30'45'', Long 122 18'12''). The sampling schedule depends on the timing of outmigration. Typically, this is focused between April – June, but in the past has ranged from February – August.

3. A description of the recent status and trends of each species and/or population and/or ESU to be taken, relative to the location(s) or area(s) of taking. (Include citations if available).

The recent status and trends of Puget Sound juvenile Chinook salmon as related to the Duwamish River has been summarized recently in the 2004 document “WRIA 9 Chinook Salmon Research Framework: Identifying Key Research Questions about Chinook Salmon Life Histories and Habitat Use in the Middle and Lower Green River, Duwamish Waterway, and Marine Nearshore Areas”. Our recent research has been coordinated along with other study programs that work under this framework within the WRIA9 watershed; this document can be reviewed online at:

<ftp://dnr.metrokc.gov/dnr/library/2004/kcr1613.pdf>

4. A description and/or completed summary table (see attached example) of estimated take per annual period, for your activities at each discrete location and/or for each project. Please separate take information into “species profiles”– groups of individuals with the same characteristics that will be undergoing the same procedures (see b-h below). Make sure you do not double-count-- if you propose to capture 50 animals, and tag 5 of those, you should list 45 animals to be captured, and 5 to be captured & tagged. Each “species profile” should include:

- a. Number of individuals;
- b. Species and/or population and/or ESU;
- c. Life stage (such as post-hatchling, fry, smolt, juvenile, immature, adult, etc. (note if live or dead))
- d. Sex (if known);
- e. Origin (if applicable, naturally-produced (wild) or artificially-propagated (hatchery));
- f. Take activity category (such as observe/harass; capture and handle; etc.);
- g. Location (if more specific than the project as a whole); and
- h. Date(s) (if more specific than the project as a whole).

See attached table

5. Estimates of potential annual mortalities by take category, including a justification. You should specify the life stage of the potential mortalities, sex if known, and whether naturally-produced (wild) or artificially-propagated (hatchery). Mortality estimates should be specific by population; by the activity causing the mortality; and/or by location when known. You should specify whether mortalities will be intentional (direct mortality) or unintentional (indirect mortality).



There will be no intentional mortalities. For each category, it is possible for some small level of unintentional mortalities to occur. From our past samplings, this ranges between 0 – 4% of the number of individuals in each take category due to stress from net sampling.

6. Provide details on how all take estimates, including mortalities, were derived. Include citations when applicable.  
All take estimates were derived from our own data from previous years, as summarized in the following table.

Start Date	End Date	# net samples	Species	Total#	#labeled	%labeled	#morts	%morts
2/15/2005	7/8/2005	30	Chinook (artificial)	556	151	27.2%	21	3.8%
			Chinook (natural)	165	75	45.5%	3	1.8%
4/12/2004	8/19/2004	7	Chinook (artificial)	161	37	23.0%	1	0.6%
			Chinook (natural)	30	16	53.3%	0	0%
5/20/2003	8/1/2003	49	Chinook (artificial)	79	30	38.0%	2	2.5%
			Chinook (natural)	49	36	73.5%	1	2.0%
6/4/2002	7/12/2002	12	Chinook (artificial)	71	0	0	0	0
			Chinook (natural)	66	0	0	0	0

## I. Transportation and Holding

N/A

1. **Transportation of a Listed Species:** Provide a description of how any live individuals taken from the capture site or other facility (including rescue and relocation activities) will be transported including:

N/A

- Mode of transportation and name of transportation company, if applicable.
- Length of time in transit for the transfer of the individual(s) from the capture site to the holding facility or to the target location.
- Length of time in transit for any planned future move/transfer of the individual(s).

- d. The qualifications of the common carrier or agent used for transportation of the individual(s).
  - e. A description of the pen, tank, container, cage, cradle, or other devices used, both to hold the individual(s) at the capture site and during transportation.
  - f. Special care before, during and after transportation (e.g., use of oxygen, temperature control, anesthetics, antibiotics, etc.)
- 2. **Holding of a Listed Species:** Describe the plan for care and maintenance of any live individuals, including a complete description of the facilities where any such individuals will be maintained including:  
N/A
  - a. The dimensions of the pool(s) or other holding facilities and the number of individuals, by sex, age, and species, to be held in each.
  - b. The water supply, amount, and quality, including controls on temperature and dissolved oxygen.
  - c. The amount and type of diet used for all individuals, and food storage.
  - d. Sanitation practices used.
- 3. **Emergency contingencies:** Identify emergency contingencies- e.g., backup life support systems, alarm systems, redundant water and oxygen supply, release or destroy decision chains, etc.  
N/A
- J. **Cooperative Breeding Program:** You must include a statement of willingness to participate in a cooperative breeding program and to maintain or contribute data to a breeding program, if such action is requested.  
We are willing to participate in a cooperative breeding program, if our data would be useful.
- K. **Previous or Concurrent Activities Involving Listed Species:**
  - 1. Identify all previous permits where you were the permit holder or primary investigator working with federally-listed species. Please identify which species.  
We were originally permitted under 1140, study 2, as a collaborator with Casey Rice/NMFS, for identical sampling for Puget Sound Chinook salmon.

2. For the above permits, please list all mortality events of listed species which have occurred in the last five years.

a. List the species, including scientific name and population where applicable;

See table under H6, for Puget Sound juvenile Chinook Salmon (*Oncorhynchus tshawytscha*), naturally-produced and artificially propagated

b. Describe the number and causes of mortalities; and

See table under H6, causes of mortalities were unintentional mortalities due to sampling.

c. Describe the measures that have been taken to diminish or eliminate such mortalities, and the effectiveness of those measures.

Mortalities can be diminished due to the improvement of measures discussed under G3, in providing adequate personnel and materials for efficient processing of captured fish in order to ensure a rapid release back to their original environment. The effectiveness of the measures appear best at small sample sizes, so increased awareness of the need to subsample during times of large catches would make the fish processing more effective in diminishing unintentional mortalities.

L. **Certification:** You must include the following paragraph, exactly as worded, followed by the applicant or responsible party's name, position title, signature and date:

"I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand this information is submitted for the purpose of obtaining a permit under the Endangered Species Act of 1973 (ESA) and regulations promulgated thereunder, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or to penalties under the ESA."

\_\_\_\_ Jason Toft \_\_\_\_\_ 1/24/06 \_\_\_\_\_  
Signature Date

Name and Position Title: Jason Toft, Fisheries Biologist

M. **Length of Time and Cost to Prepare Application (Optional):** The public burden of these application instructions is evaluated periodically by the Office of Management and Budget under the Paperwork Reduction Act. Your response will help improve the accuracy of the estimates given for evaluation. You may send comments regarding this estimate or any other aspect of this information collection, including suggestions for reducing this burden, to the Chief, Endangered Species Division, at the address under **"Where Do I Send the Application?"**

1. Please estimate the length of time, in hours, it took to compile this application.  
8 hours
2. Please estimate the cost, in \$US, of compiling this application, excluding the labor hours identified in 1. above. This estimate should include: cost of paper, printing, mailing, photocopying, etc.

### **Anticipated Annual Take**

Please use this or a similar table to specify anticipated types and numerical estimates of annual take for listed species during individual research or enhancement activities. Please use a separate table for each discrete project or location. Be sure to group take profiles so that when added up it equals the total number for which take is requested. For example, if you request to capture 50 green turtles, and you wish to attach transmitters to 5 of them, enter 45 green turtles for capture, handle, and release, and 5 for capture, handle, attach transmitter, and release.

\_\_\_\_ Jason Toft \_\_\_\_\_  
Applicant:

\_\_\_\_ Duwamish River restoration monitoring \_\_\_\_\_  
Location/Project:

<b>Number of individuals</b>	<b>Species and/or Population and/or ESU</b>	<b>Life Stage<sup>1</sup></b>	<b>Sex<sup>2</sup></b>	<b>Origin<sup>3</sup></b>	<b>Take Activity Category<sup>4</sup></b>	<b>Location<sup>5</sup></b>	<b>Date(s)<sup>6</sup></b>	<b>Details</b>
<b>300</b>	<b>Puget Sound Chinook Salmon</b>	<b>juvenile</b>	<b>N/A</b>	Artificially-propagated	<b>Capture, handle, release</b>	<b>Duwamish estuary</b>	<b>Feb-July</b>	
<b>200</b>	<b>Puget Sound Chinook Salmon</b>	<b>juvenile</b>	<b>N/A</b>	Artificially-propagated	<b>Capture, stomach flush, release</b>	<b>Duwamish estuary</b>	<b>Feb-July</b>	
<b>100</b>	<b>Puget Sound Chinook Salmon</b>	<b>juvenile</b>	<b>N/A</b>	Naturally-produced	<b>Capture, handle, release</b>	<b>Duwamish estuary</b>	<b>Feb-July</b>	
<b>100</b>	<b>Puget Sound Chinook Salmon</b>	<b>juvenile</b>	<b>N/A</b>	Naturally-produced	<b>Capture, stomach flush, release</b>	<b>Duwamish estuary</b>	<b>Feb-July</b>	

1. Such as: post-hatchling, fry, smolt, juvenile, immature, adult, etc. (also note if live or dead)
2. If known
3. If applicable, note if the species to be taken are naturally-produced (wild) or artificially-propagated (hatchery).
4. Such as observe/harass; collect for transport (including rescue/salvage); capture, handle, and release; capture, handle, tag, mark, tissue sample, and/or other invasive procedure, and release; intentional lethal take (direct mortality); unintentional lethal take (indirect mortality); removal (e.g., for broodstock collection); Other take (specify).
5. If more specific than project as a whole.
6. If more specific than project as a whole.

# PORT OF SEATTLE

## SCOPE OF WORK

### TURNING BASIN NUMBER THREE BIOLOGICAL MONITORING TECHNICAL ASSISTANCE

#### I Project Scope and Objectives

In 1999 the port completed approximately 1.3 acres of aquatic habitat restoration at Turning Basin Number Three, River Mile 5.3, in the Duwamish Waterway as a compensation action resulting from container cargo pier construction at Terminal 5, in southwest Elliott Bay.

The restoration area includes the following features: (1) approximately 1.3 acres intertidal mud and sand substrate; (2) approximately 0.44 acres emergent vegetation; and, (3) approximately 0.64 acres riparian vegetation. Recent evaluations indicate that the restoration area substrate and vegetation areas are stable as constructed.

The port requires outside professional services for the purpose of evaluating aquatic resource attributes at the Turning Basin Number Three restoration site. The following specialized technical assistance is required for assessment of the restoration site: (1) assess juvenile salmon use and diet; (2) determine abundance of benthic invertebrate food items important to juvenile salmon; (3) assess abundance of drift insects food items; and (4) analysis/evaluation of data.

#### II Description of Work

The following professional services area required for assessment and evaluation of the aquatic habitat restoration site at Turning Basin Number Three and adjacent reference sites:

1. **Analyze juvenile salmon use (presence/absence) and diet of juvenile salmon found at Turning Basin Number Three restoration site, adjacent Coastal American restoration site, and additional reference site:** Work will consist of capturing and enumerating juvenile salmon at three locations: (1) large restoration site (1999 port mitigation site); (2) adjacent Coastal America restoration site (completed in 1996); and, (3) mud and sand intertidal substrate location in adjacent Duwamish Waterway (reference location). Four sampling dates, between April and June are included. Sampling at the two restoration sites will use enclosure nets, while mud/sand flat reference site sampling will include standard beach seine net. Captured fish will be identified and enumerated, and a 50 fish subsample will include measured fork length. Each sampling event will include up to ten chum and chinook salmon sampled for diets using gastric lavage techniques, no intentional mortality or collection of chinook salmon will occur. Chum may be preserved for diet analysis if they are too small for gastric lavage techniques.
2. **Benthic macrofauna sampling:** Benthic core samples will be obtained from the three sites identified, coincident with four dates when juvenile salmon sampling takes place. Intertidal mud and sand substrate will be sampled in each of the restoration locations and at 0.0 feet MLLW elevation restoration and reference sites sampled in previous Coastal

America evaluation projects. Core sampling methodology and analysis will be consistent with previous Duwamish Waterway sampling projects.

3. **Benthic meiofauna sampling:** Benthic core samples will be obtained as described above and analyzed for meiofauna.
4. **Sampling of drift insects:** The three locations included above will be evaluated for potential drift insects using fall-out traps. Fall-out traps will be located in riparian and emergent plant areas, including seven replicated traps used consistent with the time and site of sampling described above.
5. **Data analysis description:** Enclosure net information will be used to estimate fish densities per unit surface area or volume of site. Densities will be compared between the restored sites using standard graphical and statistical techniques. Fish densities will also be derived from reference beach seine sampling locations and compared to computed restoration site densities. Juvenile salmon diet data will include enumeration of and weight of prey, statistical analysis of numerical and weight percentages, frequency of occurrence, and preparation of an index of relative importance for each prey type. If sufficient fish are captured, a comparison of diets between sampling sites and dates will be prepared using similarity indices. Benthic macro and meiofauna and drift insects will be enumerated and expressed as mean numbers per square meter. Between-site differences/comparisons will be evaluated using graphic representations of the data and application of appropriate standard parametric statistics. It is noted that substantial data variances for within- and between site invertebrate means have been reported in previous, similar Duwamish Waterway sampling efforts and parametric statistics will not be useful for this type of data.
6. **Additional data analysis:** This task includes additional analysis and evaluation of data obtained from 2004 and 2005, integrating and presenting data in a comprehensive document.

**Schedule:** Field sampling will be conducted April through June 2006. Sample processing and laboratory work will take place June through October 2006. Data analysis and report preparation will take place in November/December 2007. A final report will be submitted within two weeks of the port's review of a draft report.

### **III Project Management and Communication**

The project manager for the port will be Geo. Blomberg, responsible for providing information describing the port's restoration projects and other site information as required. J. R. Cordell and Jason Toft will be the principal research scientists and project managers, representing the School of Aquatic and Fisheries Sciences, University of Washington, for the scope of work outlined in this attachment.

## **ATTACHMENT A**

**(SPU Agreement No. DA2004-56)**

### ***SCOPE OF SERVICES AND SCHEDULE***

#### **2005 DUWAMISH STUDY**

##### **Project Description and Purpose**

The WRIA 9 Technical Committee (W9TC) received grant funds from the Salmon Recovery Funding Board and the King Conservation District to conduct a habitat assessment and utilization study in the Lower Green River, Duwamish Estuary and Marine Nearshore of Central Puget Sound. The W9TC prioritized these data gaps and identified the following hypothesis as a top priority for 2005 research efforts:

- The upper estuary (Trimaran, Turning Basin and adjacent areas, ~RM 5.5-7) is a key rearing habitat that supports both fry and fingerling migrants with adequate habitat capacity.

The W9TC also felt that additional information should be collected to address other research hypotheses in the Duwamish River (estuary) where there was economic saving to collecting additional information during this effort, rather than a separate study. Therefore, the 2005 study plan for the Duwamish focuses on two study topics: (1) Fish Distribution, and (2) Habitat Site Productivity. The University of Washington work under this MOA will address the Habitat Site Productivity Study Plan.

Work conducted by the Wetland Ecosystem Team at the University of Washington will seek to answer the primary question: What is the relative productivity of various restored and non-restored habitats in the Duwamish estuary for juvenile Chinook? The proposed research is designed to help answer this question and provide information about optimal restoration methods for Chinook salmon in the Green/Duwamish river system.

##### **Scope of Services**

The central methodology will involve comparing prey abundance and availability and potential growth of juvenile Chinook among different restored and reference sites. Restored sites in the Duwamish estuary consist mostly of created habitats designed to provide wetland functions, and reference sites will be non-restored areas along the main waterway. Three pairs of restored/reference sites will be chosen, one at the Turning Basin, and one both upstream and downstream of the Turning Basin. Sampling will be conducted throughout the outmigration period, monthly from February to June to capture both fry and fingerling outmigration of juvenile Chinook salmon. Some elements of this study will be designed to complement the beach seining being conducted by the Fish Distribution Study Plan.

##### **Task 1. Project management and collaboration.**



Because this scope of work is one piece of a larger Duwamish study plan, there is an increased need to collaborate with other researchers working on this effort. The UW will collaborate with the SPU project manager and relevant researchers to work together in the most effective and efficient manner possible.

**Task 2. Testing the hypothesis: Restored sites provide increased productivity for juvenile Chinook salmon, as measured by growth efficiency (bioenergetic output).**

Research Background: By using physical and biological habitat characteristics, such as temperature and prey quality and quantity, combined with diet and consumption data from foraging fish, bioenergetics models can determine relative site-specific fish growth rate. Such models are useful in helping to define restoration success in providing site specific growth potential, which in turn can be related to fish survival.

Study Design: Data collected to construct a bioenergetic model for restored and reference sites in the Duwamish Waterway will consist of:

1. Determining the consumption rate of the fish by (a) estimating stomach fullness or a ratio of stomach contents weight to fish weight by non-invasive gastric lavage techniques, no intentional mortality or collection of fish will occur, and (b) sampling fish periodically throughout a 24 hour period in order to determine amount of food eaten per unit time; this would require the assumption that all of the fish behave similarly all the time and that feeding is taking place at the location of interest. These two assumptions can be improved by conducting consumption rate sampling on several dates, and by using enclosure nets to insure on-site feeding at restoration sites (but this will not be able to be done for a 24 hour period because of site elevations).
2. Identifying prey in the different locations being compared. It is assumed that this information will come from diet analyses conducted as part of the larger 2005 Duwamish study.
3. Water temperature, ideally measured throughout the tidal cycle and seasonally. The best way to do this would be with data loggers.
4. Energy content of the prey consumed by the fish. Ayesha Gray (WET PhD student) has compiled much of this data for the Salmon River, Oregon, and other students have done this for Lake Washington, but diets in the Green/Duwamish may have some items for which we will need to assign a value from the literature as well as collect them in the field and do our own bomb calorimetry.

Expected Results: A successful bioenergetics model will allow an estimate of fish growth potential at each site tested. This will comprise a useful tool in comparing the relative value of the three restoration sites sampled, as well as comparing salmon growth potential at restored and non-restored sites.

**Task 3. Analysis and reporting.**

Diet and prey samples will be analyzed in the laboratory. Analysis of the diet data, prey compositions, water temperatures and energy content will be conducted through using bioenergetic modeling. Data will be summarized in a final report, addressing the research hypothesis. It is expected that one report will be prepared for all work conducted under the 2005 Duwamish study plan and the UW will work with the SPU project manager, W9TC and relevant consultants to assist in development, review and revision of the project report.

### **Schedule and Deliverables**

January 2005 Organize field equipment, arrange schedule and sampling design.

February-July 2005 Conduct field sampling.

August-December 2006 Process samples, analyze data, conduct bioenergetic modeling.

January-February 2006 Write relevant sections of the draft report, coordinating with other researchers involved in the collective 2005 Duwamish research effort.

February 15, 2006 Draft report on entire project due to SPU project manager for review.

March 1, 2006 Review comments due back to relevant consultants, including UW.

March 15, 2006 Complete revised Final Report due to SPU project manager.